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(To be launched no earlier than Aug. 25)

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APOLLO SATURN
HEAT SHIELD
IN ORBIT TEST

The third unmanned Apollo/Uprated Saturn I flight will be launched no earlier than Aug. 25. This will be the second flight test of the Apollo spacecraft command and service modules and the third flight test of the Saturn I rocket in preparation for manned missions orbiting the Earth.

The 17,825-mile flight will carry the spacecraft three-quarters of the way around the Earth. Landing will be in the north central Pacific about 300 miles southeast of Wake Island.

The National Aeronautics and Space Administration will launch the space vehicle from Launch Complex 34, Kennedy Space Center, Fla., at 12:30 a.m. EDT to provide a long period of daylight for spacecraft recovery operations. The flight will take almost 93 minutes.

The mission is the second performance check of the Apollo command module ablative heat shield. The shield will be subjected to extended high heat loads -- about 23,000 BTU/per square foot -- resulting from a reentry path resembling a "roller coaster" ride on Earth.

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8/15/66

On the first unmanned Apollo mission last February, the heat shield underwent high heating rates at a very steep angle. The reentry trajectory in this mission will be longer and shallower to produce very high heat loads.

The two types of trajectories represent reentry heating conditions encountered in manned Earth orbital missions. For lunar landing mission reentry, the spacecraft heat shield will be tested next year on Saturn V missions.

The Apollo/Uprated Saturn space vehicle stands 224 feet high (launch vehicle is 141 feet and spacecraft 83 feet). Total weight on the launch pad will be 1,326,400 pounds (launch vehicle is 1,269,500 pounds and spacecraft 56,900 pounds).

The Apollo command module, although unmanned, is a fully operational spacecraft except for crew couches and a few displays for pilots. The guidance and navigation system and fuel cell electrical power system will undergo their first flight test.

The Apollo Emergency Detection System will be tested in the automatic mode. It will automatically initiate firing of the spacecraft launch escape system and separation of the command module if two of the Saturn first stage engines fail, or if a guidance failure causes excessive pitch, yaw and roll during first-stage powered flight.

On manned missions, the emergency detection system can operate automatically or it will signal the crew to initiate firing of the escape system. Relay logic of the emergency detection system is located primarily in the Saturn vehicle instrument unit.

The first test of S-Band communications will be conducted on the mission, although it will not be the prime method of air-to-ground communications. The Apollo Unified S-Band system will be fully operational for Saturn V manned missions in 1968.

The 21,500 pound thrust service propulsion system engine will be fired four times in flight for a total of more than five minutes. On Apollo lunar landing missions, this engine will provide thrust for the spacecraft to correct velocities en route to the Moon, break into lunar orbit and return to Earth.

A structural test of the common bulkhead separating the Saturn second stage propellant tanks will be conducted after the stage separates from the spacecraft. Similar to the check on the second Uprated Saturn I mission, it is designed to determine the strength of the sandwich-like structure which insulates the liquid oxygen at minus-297 minutes degrees F. from supercold liquid hydrogen at minus-423 degrees F.

Ground tests and the previous flight test show that the bulkhead will withstand pressure differentials of about 34 pounds per square inch -- more than three times normal operating conditions. Maximum pressure is expected as the stage reenters the atmosphere over the Atlantic.

Pressure differential reached will depend on the amount of liquid oxygen remaining in the tank. It is not known whether this will cause the stage to break up as it did in the previous Saturn flight last month.

Six movie cameras and one television system will record data (See Cameras, Page 23). A total of 2,158 measurements will be recorded during the mission, 863 from the Apollo spacecraft and 1,295 from the Saturn.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS)

THE MISSION

Countdown for the Apollo/Uprated Saturn (AS-202) vehicle at Launch Complex 34 will begin about 25½ hours before liftoff. During the early phases of the count final checks of the spacecraft, ordinance arming and mechanical work on the launch vehicle will be accomplished.

Liquid oxygen loading to both stages of the Saturn launch vehicle will begin six hours before scheduled liftoff. Liquid hydrogen loading to the second stage will begin four hours before launch.

Hatches of the spacecraft will be sealed 45 minutes before liftoff, and 15 minutes later the Apollo access swing arm on the umbilical tower will be retracted.

Terminal phase of the countdown will begin 30 minutes before launch. At 2 minutes 43 seconds before liftoff the countdown will go on automatic sequence.

The vehicle will be held on the pad for about three seconds after the eight first-stage engines ignite to assure stable combustion. It will lift off the pad on an azimuth of 100 degrees East of North, roll to 105 degrees and begin to pitch or tilt along the flight path, a southeasterly direction from Cape Kennedy.

The first stage burns for 2 minutes 23.7 seconds and the stage is separated. The booster propels the vehicle to a 35-mile altitude and 35 miles down range. The stage impacts about 270 miles downrange near Antigua.

Two recoverable movie cameras mounted on the forward end of the first stage will record separation and ignition of the second stage (See Cameras, Page 23).

A few seconds after the second stage J-2 engine ignites, the spacecraft launch escape system is jettisoned. The engine burns for about 7 minutes 23 seconds producing thrust to carry the vehicle to a 135-mile altitude some 969 miles from the launch site.

About 10 seconds after second stage cutoff the spacecraft separates from the stage and Saturn instrument unit. A television camera mounted in the instrument unit will record movement of the spacecraft lunar module adapter panels as they fold back to free the spacecraft. The adapter will house the lunar module on later Earth orbital flights and lunar landing missions. Signals from the camera will be monitored and recorded at the Antigua tracking station (See Cameras, Page 23).

The pressure test of the second stage common bulkhead will begin 90 seconds after spacecraft separation. The liquid oxygen tank vent valve will be opened and the liquid hydrogen tank vent valve will be closed. This will cause the pressure differential across the bulkhead to increase. The amount of increase will depend on the amount of liquid oxygen remaining in the tank. Maximum pressure is expected to be reached as the stage reenters the atmosphere over the Atlantic Ocean.

A few seconds after spacecraft separation the 21,500-pound thrust service module propulsion engine will be fired for the first time. This burn of three minutes 35 seconds will boost the spacecraft to its peak altitude of 706 miles over South Africa about 41 minutes after liftoff.

The second service propulsion engine burn, of one minute 28 seconds, will occur approximately 25 minutes later over the Indian Ocean near the Western tip of Australia.

About 10 seconds later, the third and fourth burns, each of three seconds duration, take place. These are to test the rapid restart capabilities of the engine.

The spacecraft guidance and control system will orient the spacecraft for separation of the command and service modules about two minutes after the fourth service propulsion burn. The 100-pound thrust service module reaction control engines are fired to separate it from the command module.

A few seconds after separation the command module will be oriented for the long shallow reentry. From an altitude of 400,000 feet it will descend to 218,000 feet at a speed of more than 19,000 miles per hour. At this time the guidance and navigation system will initiate the reaction control system to modulate the lift vector and the spacecraft will skip back to an altitude of about 264,400 feet.

From this altitude the final phase of reentry begins at a velocity about 16,000 miles per hour.

The apex cover of the spacecraft will be jettisoned to deploy the two 13-foot diameter drogue parachutes at 23,850 feet altitude. The three 83-foot diameter main parachutes are deployed at 10,350 feet. Splashdown is expected one hour, 32 minutes, 54 seconds after liftoff.

The predicted landing point for the mission is at 17 degrees 9 minutes N latitude and 171 degrees 87 minutes E longitude, located in the downrange portion of the terminal landing footprint. The terminal landing "footprint" is an area 3,500 nautical miles long, varying between 200 and 300 nautical miles in width cutting between the Caroline and Marshall Islands with impact point 300 miles southeast of Wake Island in the North Central Pacific.

The aircraft carrier, USS Hornet, two destroyers and seven C-130 aircraft comprise the Department of Defense recovery force in the area. The USS Hornet will be at the predicted impact area.

Should the spacecraft's guidance system fail, a ballistic reentry will be achieved and landing will be in the uprange portion of the long footprint. This impact point is approximately 1,000 miles uprange in the vicinity of the Caroline Islands, north of New Guinea.

After recovery the Command Module will be taken to Downey, California, for post-flight analysis by NASA and North American Aviation engineers.

FLIGHT SEQUENCE

Hour	Minutes	Seconds	Event
	00	00	Lift-off
	00	10	Pitch and roll maneuver initiated
	00	15	Roll terminated
	01	19	Maximum dynamic pressure (altitude 7.8 miles, 2.5 miles downrange, velocity 1,010 miles per hour).
	02	15.7	Pitch terminated
	02	20.7	First stage inboard engines cutoff
	02	23.7	First stage outboard engines cutoff (altitude 35 miles; 35 miles downrange, velocity 4,150 mph)
	02	24.3	Second stage ullage rocket ignition
	02	24.5	First stage separates
	02	26.13	Second stage ignition
	02	49.55	Camera capsule ejected from separated S-IB
	02	50	Launch escape system jettison
	02	52.55	Initiate active guidance
	10	01.35	Second stage engine cutoff (altitude 135 miles, 969 miles downrange, velocity 14,300 mph).
	10	11	Separation of spacecraft from Saturn second stage
	10	22	First burn Service Propulsion System Engine (SPS), 215 seconds
	11	52	Second stage bulkhead test begins
	13	57	First burn concluded
	41	25	Apogee reached, 706 statute miles

Hour	Minutes	Seconds	Event
1	05	38	RCS ullage burn
1	06	08	Second burn SPS, 88 seconds
1	07	36	Second SPS burn concluded
1	07	46	Third SPS burn, 3 seconds
1	07	49	Third SPS burn concluded
1	07	59	Fourth burn SPS, 3 seconds
1	08	02	Fourth SPS burn concluded
1	09	58	CM/SM separation attitude
1	11	16	CM/SM separation sequence starts (150 seconds RCS burn SM)
1	11	17	CM/SM separation
1	11	56	CM reentry attitude
1	12	38	CM at 400,000 foot altitude
1	13	36	Blackout begins
1	23	36	Blackout ends
1	26	58	Apex cover jettisoned
1	27	00	Drogue chute deployed
1	27	52	Main chute deployed at 10,350 feet
1	32	54	Splashdown

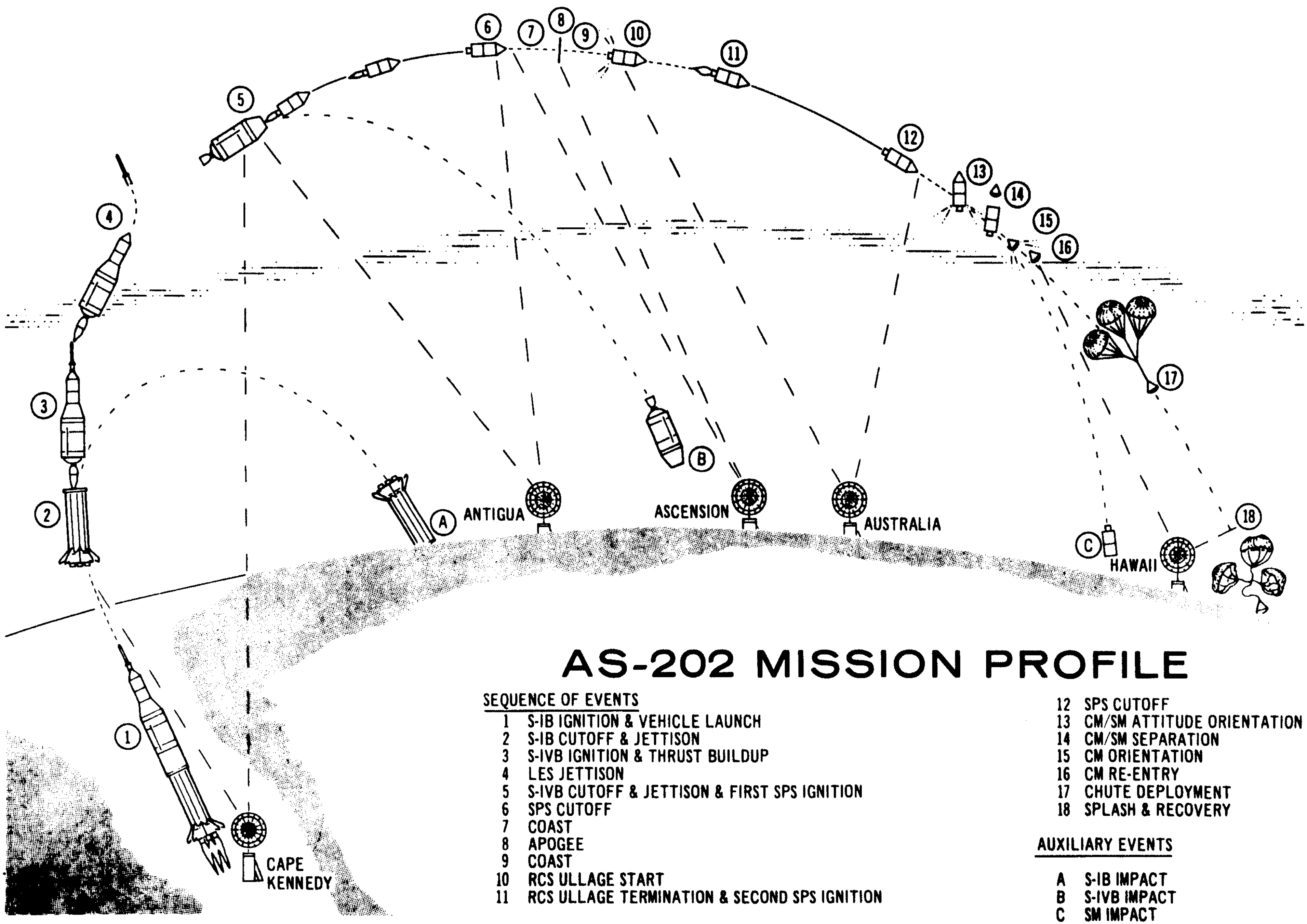
MISSION CONTROL AND TRACKING

The Manned Space Flight Control Center at the Manned Spacecraft Center, Houston, will control the mission from liftoff through recovery of the spacecraft. The second floor Mission Operations Control Room will be used as it was for the Apollo/Uprated Saturn I missions last February and July.

Real-time in-flight analysis and monitoring of the onboard systems by flight controllers will be accomplished through data transmitted from Air Force Eastern Test Range and the NASA Manned Flight Tracking Network tracking facilities.

Stations participating will be Kennedy Space Center, Patrick AFB, and Merritt Island in Florida; Bermuda; Grand Bahama Island; Grand Turk Island; Antigua; Ascension Island; Pretoria, South Africa, and Carnarvon in Australia.

In the Atlantic Ocean, the tracking ship Rose Knot Victor will monitor spacecraft separation in addition to receiving other telemetry data. Two tracking ships in the western Pacific will be the Coastal Sentry Quebec, which will monitor separation of the command and service modules before reentry, and the Wheeling.



AS-202 MISSION PROFILE

SEQUENCE OF EVENTS

1 S-IB IGNITION & VEHICLE LAUNCH
2 S-IB CUTOFF & JETTISON
3 S-IVB IGNITION & THRUST BUILDUP
4 LES JETTISON
5 S-IVB CUTOFF & JETTISON & FIRST SPS IGNITION
6 SPS CUTOFF
7 COAST
8 APOGEE
9 COAST
10 RCS ULLAGE START
11 RCS ULLAGE TERMINATION & SECOND SPS IGNITION
12 SPS CUTOFF
13 CM/SM ATTITUDE ORIENTATION
14 CM/SM SEPARATION
15 CM ORIENTATION
16 CM RE-ENTRY
17 CHUTE DEPLOYMENT
18 SPLASH & RECOVERY

AUXILIARY EVENTS

A S-IB IMPACT
B S-IVB IMPACT
C SM IMPACT

PRELAUNCH CHECKOUT

The uprated Saturn I launch vehicle -- first stage (S-IB), second stage (S-IVB), and instrument unit (IU) -- arrived at Cape Kennedy in January and February. They were erected inside the Complex 34 service structure in March.

The Apollo spacecraft, command module, service module and lunar module adapter, arrived at the NASA Kennedy Space Center in April. The command module underwent extensive environmental control system checks and was taken to the pyrotechnic installation building where it was mated with the launch escape system.

After receiving and inspection, the service module was taken to Complex 16 on Cape Kennedy for checks of its secondary propulsion system. Then it was returned to the Kennedy Space Center for fuel cell installation and tests in an altitude chamber which simulates the near-vacuum of space.

The lunar module adapter and the service module were mated near the end of June. Mate of the Apollo modules with the launch vehicle was accomplished in early July.

Tests of the integrated launch vehicle and spacecraft followed at Complex 34. A full-scale countdown demonstration was conducted by the launch team about three weeks before the scheduled launch date. During the demonstration, actual countdown was followed to ignition and liftoff. This included loading the launch vehicle with cryogenic propellants -- liquid oxygen and liquid hydrogen.

As in previous Uprated Saturn I flights, much of the checkout of both launch vehicle and spacecraft was accomplished through the use of computers. Launch vehicle automatic checkout -- already used to a great extent in Apollo spacecraft tests -- will be progressive with each succeeding flight.

The Saturn V launch vehicle, for the most part, will signify the ultimate in automatic checkout when most of its preparation is accomplished through the use of computers. Two RCA 110-A computers, one located at the base of the launch pad and one in the launch control center are used for checkout of the Saturn.

Spacecraft computer checkout uses a system called ACE/SC (acceptance checkout equipment for spacecraft). The ACE system provides reliable, instantaneous, accurate checkout of the systems with computers, display consoles and recording equipment.

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ACE, also used at spacecraft contractor plants and at NASA's Manned Spacecraft Center, Houston, is manufactured by General Electric, Apollo Support Department, Daytona Beach, Fla.

While automatic checkout of the various systems of the spacecraft and the launch vehicle are being carried out independently at the Kennedy Space Center and on the launch complex at Cape Kennedy interface instrumentation joins the two systems for a picture of the overall prelaunch preparation.

APOLLO SPACECRAFT

The spacecraft consists of two modules which are fastened together in tandem, the Apollo command and service modules. The launch escape system is atop the command module. An adapter section is located between the service module and the launch vehicle which will house the lunar module on future Apollo flights.

Command Module

Although this is an unmanned mission, the instruments and equipment in the command module will be fully operational, with the exception of a few astronaut-oriented displays. It consists of a pressurized compartment of aluminum honeycomb and an outer heat shield of stainless steel honeycomb.

Shape:	Conical (cone)
Height:	11.5 feet
Diameter at base:	13 feet
Launch weight:	11,900 (including RCS propellants)
Outer structure:	Stainless steel brazed honeycomb bonded between aluminum alloy sheets. An ablative material which varies from 1/2 inch to 2-1/2 inches is applied to entire outer surface.
Inner compartment:	Aluminum honeycomb bonded between aluminum alloy sheets. Thickness ranges from 1-1/2 inches at base to 3/4 inch at forward bulkhead.
Insulation:	A two-layer micro-quartz fiber insulation 1/2 inch-thick separates the walls of the inner and outer structures.

Electrical:	Six silver oxide-zinc batteries with a capacity of 40 ampere hours provide entry, post landing and pyrotechnics energy.

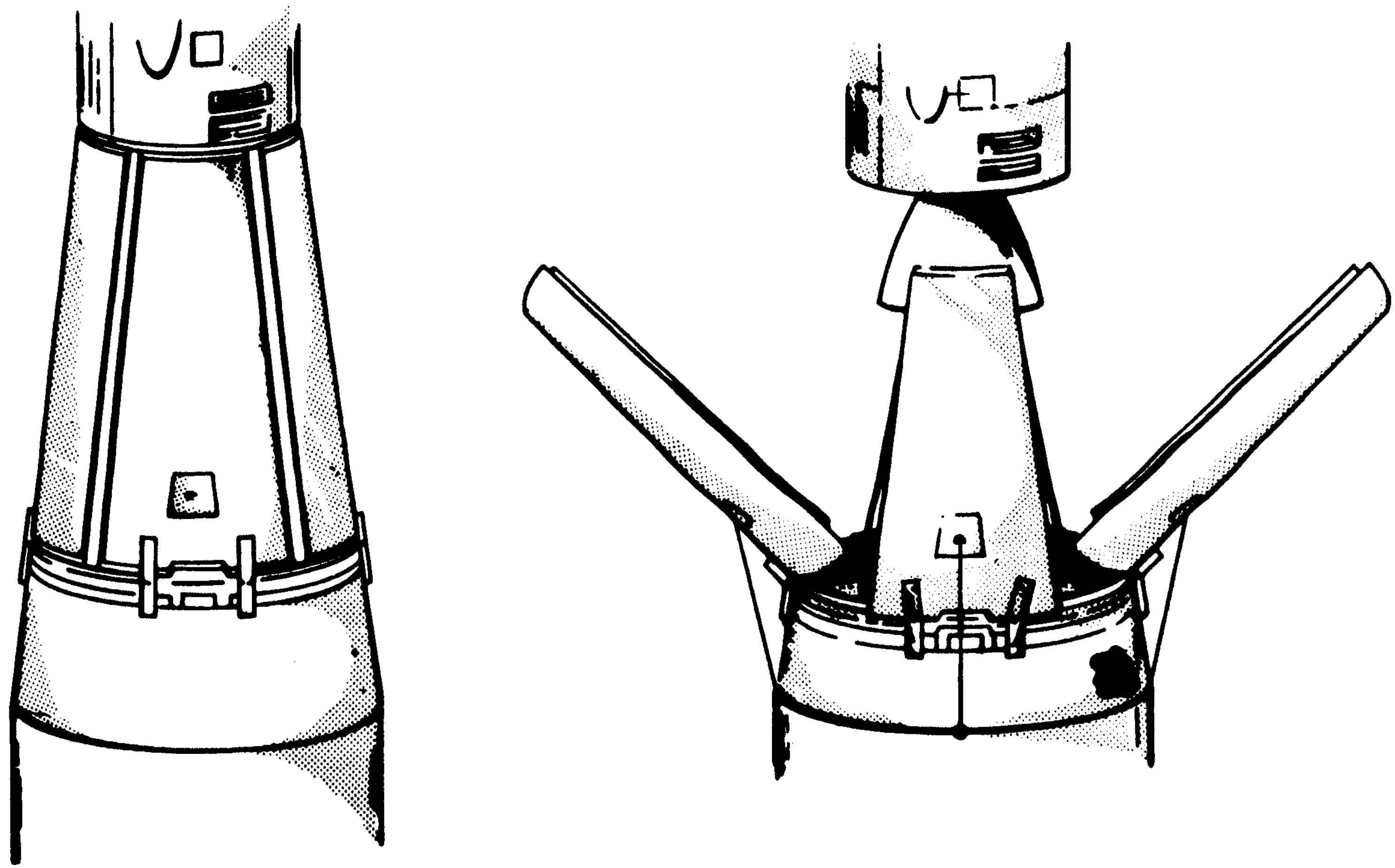
Service Module

The service module is an unpressurized cylindrical shell which houses the main propulsion engine, propellant tanks, electrical power system, reaction control engines and portion of the environmental control system in a six pie-shaped section. Three fuel cells, each with the capability of producing 1,420 watts, will fly on this mission.

Shape:	Cylinder
Height:	24.6 feet (including main propulsion engine
Diameter:	13 feet
Launch weight:	9,800 pounds (structure) 23,000 pounds (propellants) 32,800 Total
Structure:	Aluminum honeycomb panels one inch thick bolted to six solid aluminum field beams that are chemically milled to within .007 inches (seven thousandths).
Electrical power:	The electrical energy source for the spacecraft throughout the mission until the command module separates from the service module is provided by the three fuel cells.

Spacecraft Lunar Module Adapter

This adapter joins the service module and the S-IVB instrument unit. In future flights it will house the lunar module, but on this flight an aluminum alloy bracing is included in its place. The adapter is 28 feet high and tapers from 22 feet at the instrument unit end to 13 feet where it attaches to the service module. It weighs 3,700 pounds. It consists of four aluminum honeycomb panels attached by hinges to the lower end of the adapter. The panels may be separated by explosive charges and opened petal-like to expose the lunar module preparatory to CSM lunar module docking on future flights.



Apollo Spacecraft Lunar Module Adapter
Left - at lift-off
Right - Service Module Separation

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MAJOR APOLLO SPACECRAFT SYSTEMS

Boost-Protective Cover (BPC)

The boost-protective cover protects the command module from aerodynamic heating during boosted flight and from heat and soot from the launch escape and jettison motors of the launch escape system. It is made of ablative cork and Teflon-impregnated glass cloth supported by glass honeycomb in the upper portion. It is jettisoned with the launch escape system at 268,000 feet altitude less than three minutes after liftoff.

Launch Escape System (LES)

The launch escape system is 33 feet tall and consists of an escape motor, pitch control motor, tower jettison motor, tower release mechanism, canard subsystem and Q-ball assembly. It weighs about 8,500 pounds.

The launch escape motor is 26 inches in diameter, 15 feet, 3 inches long and burns about 4,700 pounds of solid propellant to provide 155,000 pounds of thrust.

The pitch control motor is nine inches in diameter, 22 inches long, and burns solid propellant.

The tower jettison motor is 26 inches in diameter, 47 inches long, uses solid propellant and develops about 33,000 pounds of thrust. It removes the LES after the second stage ignition.

The tower release mechanism consists of four explosive bolts which separate just before the jettsion motor or escape motor ignites to detach the LES from the command module.

The canard subsystem is mounted in the pitch control motor housing near the top of the launch escape system. Each of two wing-like canard surfaces is about 18 inches wide and 24 inches long. The aerodynamic surfaces are deployed by explosives 11 seconds after the escape motor fires during an abort. They stabilize the command module blunt end forward prior to drogue chute deployment.

The Q-ball assembly is at the top of the launch escape system and contains pressure sensors to determine flight angles of attack and dynamic pressures during launch or launch abort.

Command Module Guidance and Navigation System

The system consists of inertial, computer and optical subsystems. During this unmanned mission the optical subsystems, telescope and sextant, will be inactive.

A control programmer will perform tasks normally done by the astronauts.

The computer will be activated to determine spacecraft velocity and attitude and reentry angle.

Command Module Attitude Control and Stabilization System

The system, composed of 12 small rocket engines installed in independent, identical sets of six, provides onboard propulsion for positioning reentry into the Earth's atmosphere. Fast acting valves enable the engines to be fired in short bursts to 30 per second to position the spacecraft precisely during reentry. Thirty bursts (pulses) per second is about the rate a spark plug fires in an automobile engine operating at 3,000 revolutions per minute, or about 70 mph.

Thrust:	93 lbs. per engine
Length:	11 inches
Diameter:	5 inches
Weight:	8.3 lbs.
Propellants:	Monomethylhydrazine (fuel) and nitrogen tetroxide (oxidizer). Combination is storable and hypergolic - 270 lbs. on this mission.
Components:	Ablative thrust chambers, fast acting valves, and detachable nozzle extension.
Pulse frequency:	30 cycles per second

Earth Landing System (ELS)

Besides the sequence controller, the Earth landing system consists of two nylon conical ribbon drogue parachutes 13 feet in diameter; three ringslot nylon pilot chutes, seven feet in diameter; and three ringslot, nylon main chutes 83.5 feet in diameter.

At 24,000 feet altitude, after reentry, a barometric switch activates pyrotechnics which jettison the apex heat shield to uncover the parachutes.

Two seconds later the drogue chutes are deployed by mortar to stabilize the spacecraft blunt end forward. The drogues are reefed for eight seconds, then fully opened by reefing cutters.

The pilot chutes are deployed about 10,350 feet, pulling the three main parachutes from their containers. The main chutes also are reefed for eight seconds until cutters permit the large canopies to open fully.

The VHF recovery and survival antennas and a flashing light are deployed after the main chutes disreef, the survival and recovery beacons begin operation before touchdown.

If the spacecraft lands with its apex end in the water, the control programmer will signal a pump one minute after splashdown to inflate one of three flotation bags. Five minutes later, if the spacecraft is still not upright a second pump inflates another bag, and if necessary five minutes later the third bag will inflate.

When upright, other aids, such as the HF transmitter and flashing light begin operation.

Power Supply System

Power for the spacecraft will be furnished by two of three fuel cells carried in the service module. Maximum gross power of these two units is 2,840 watts (29 volts). The cells weigh 240 pounds each and use oxygen and hydrogen as reactants. A total of 672 pounds of liquid oxygen (in two tanks) and 60 pounds of liquid hydrogen (in two tanks) will be carried. The third fuel cell will not function during this mission.

Service Module Main Propulsion System (SPS)

This system provides thrust required for large changes in spacecraft velocity after launch vehicle separation.

In orbital missions the SPS will be used for orbital changes and retrofire, and on a lunar journey will provide midcourse corrections and velocity changes for entering and leaving lunar orbit.

Two electrically operated servo-actuators provide the SPS engine with the capability of gimballing action. SPS propellants (fuel and oxidizer) are kept to the bottom of the tanks for proper flow into engine pumps by maneuvers performed by the SM reaction control system.

During this flight the restartable engine will be fired four separate times for a total of 5 minutes and 25 seconds.

DESCRIPTION:

Engine Thrust	21,500 pounds Engine is capable of operating for 12 and a half minutes in various time increments involving up to 50 separate periods of operation.
Propellants	7,500 lbs. of UDMH (fuel) 15,180 lbs. of nitrogen tetroxide (oxidizer)
Height	12 feet 7 inches
Weight	770 lbs.

Service Module Reaction Control System

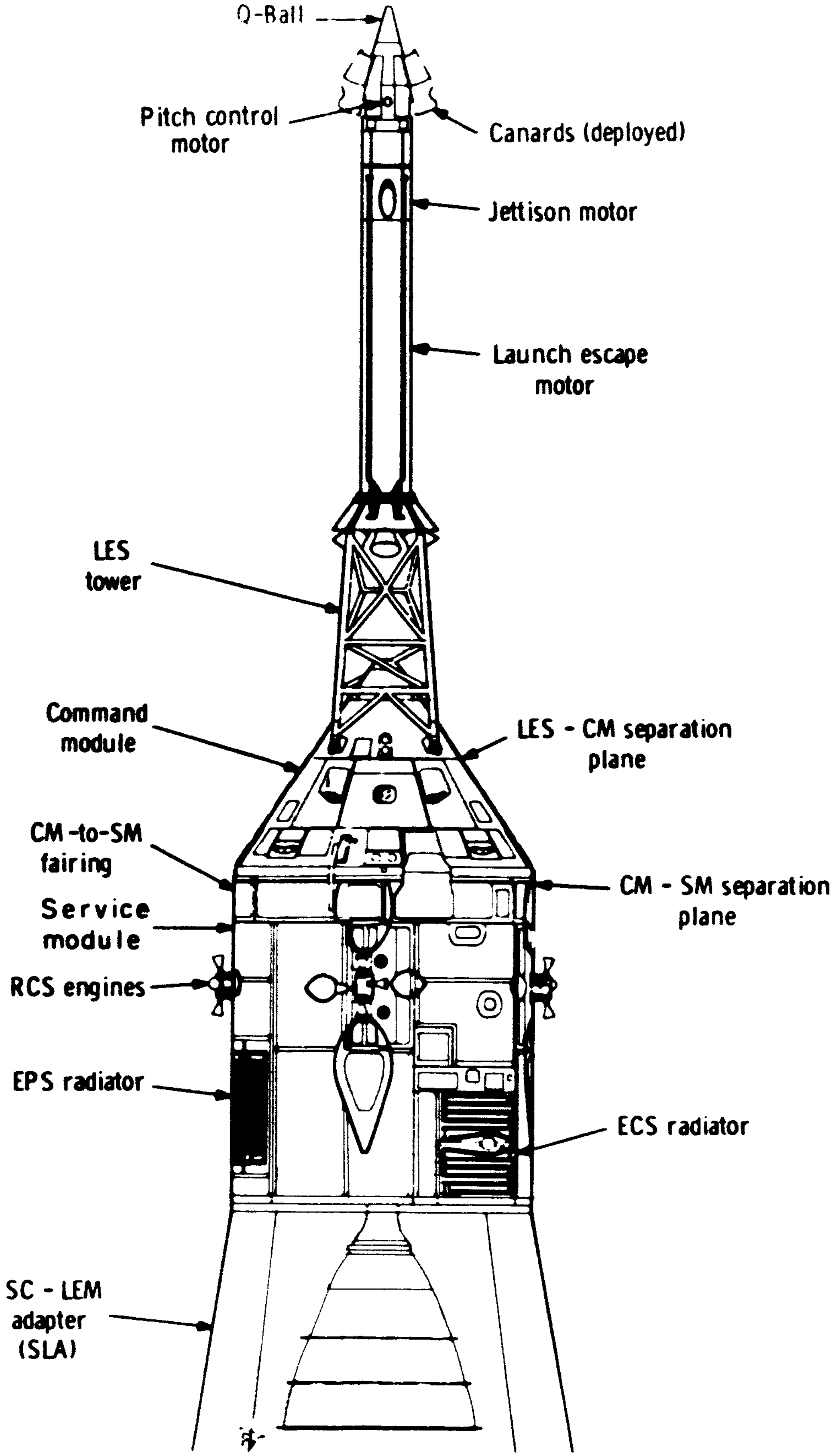
Sixteen small rocket engines are used to carry out ullage requirements, perform stabilization maneuvers during flight and to separate service and command modules prior to reentry. They are arranged in clusters of four.

FUNCTION:	Positioning of SM, ullage requirements for SPS propellants, separation SM/CM

DESCRIPTION:

Number	16 clustered in four quadrants

Propellants	Nitrogen tetroxide and hydrazine 50-50 UDMH - (838 lbs. carried on this mission)
Size	14 inches long, largest diameter six inches
Weight	5 pounds
Thrust	100 lbs. (each engine)



APOLLO SPACECRAFT (without boost protective cover)

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THE UPRATED SATURN I LAUNCH VEHICLE

The Uprated Saturn I launch vehicle was conceived in 1962 at the NASA Marshall Space Flight Center as the quickest, most reliable, and most economical means of providing a vehicle with greater payload capability than the Saturn I for suborbital and orbital Apollo missions before the Saturn V would be available.

The design was based on using two existing stages of Saturn I and Saturn V vehicles, redesigned Saturn I booster (the S-IB stage) and the third stage (S-IVB) and instrument unit from the Saturn V.

The concept permitted rapid development of the vehicle, and maximum use of designs and facilities from other Saturn programs saved time and money.

Two Uprated Saturns launched earlier this year on Feb. 26 and July 5 continued the string of 10 Saturn I successes.

The Uprated Saturn I, including two stages and an instrument unit, is 141 feet tall. Mated with the 83-foot Apollo spacecraft the entire space vehicle stands 224 feet high on the launch pad.

First stage -- The 202 stage is 80 feet long, 21½ feet in diameter. Dry weight is 91,600 pounds.

Design changes have been made in the Saturn I booster to reduce weight. However, the first stage for this flight was one of two boosters in the series initially designated a part of the Saturn I program and some of the weight reducing changes were not incorporated.

The second flight Uprated Saturn I stage, flown in July, was the first of the boosters incorporating virtually all of the weight reduction changes. Dry weight of that stage, 86,200 pounds, was reduced by about 20,000 pounds over the basic S-I. This was done by redesigning the fins, removing hydrogen vent pipes and brackets unnecessary to the new design, resizing machine parts in the tail section assembly, redesigning the spider beam and modifying the propellant tanks.

Eight H-1 engines producing a total thrust of 1.6 million pounds power the stage. The engines, made by Rocketdyne, burn liquid oxygen and RP-1 fuel. In approximately 2½ minutes of operation, the stage burns 40,000 gallons (270,500 pounds) of RP-1 fuel and 64,000 gallons (611,000 pounds) of liquid oxygen, to reach an altitude of about 35 miles at engine cutoff.

Four of the Rocketdyne H-1 engines are mounted in a square pattern in the center of the stage's thrust structure section. The other four are mounted in a square pattern near the outer edge of the thrust structure. The outer engines are equipped with independent, closed-loop hydraulic systems which gimbal the engines as much as eight degrees for vehicle flight direction control.

The stage is made up of eight 70-inch diameter propellant tanks (Redstone type) surrounding a single 105-inch (Jupiter type) tank. The center tank and four of the outer ones hold liquid oxygen, and the other four contain RP-1 (kerosene). The tanks are interconnected at the bottom to provide the capability of completing the mission in case one engine fails. This capability was demonstrated in two Saturn I flights.

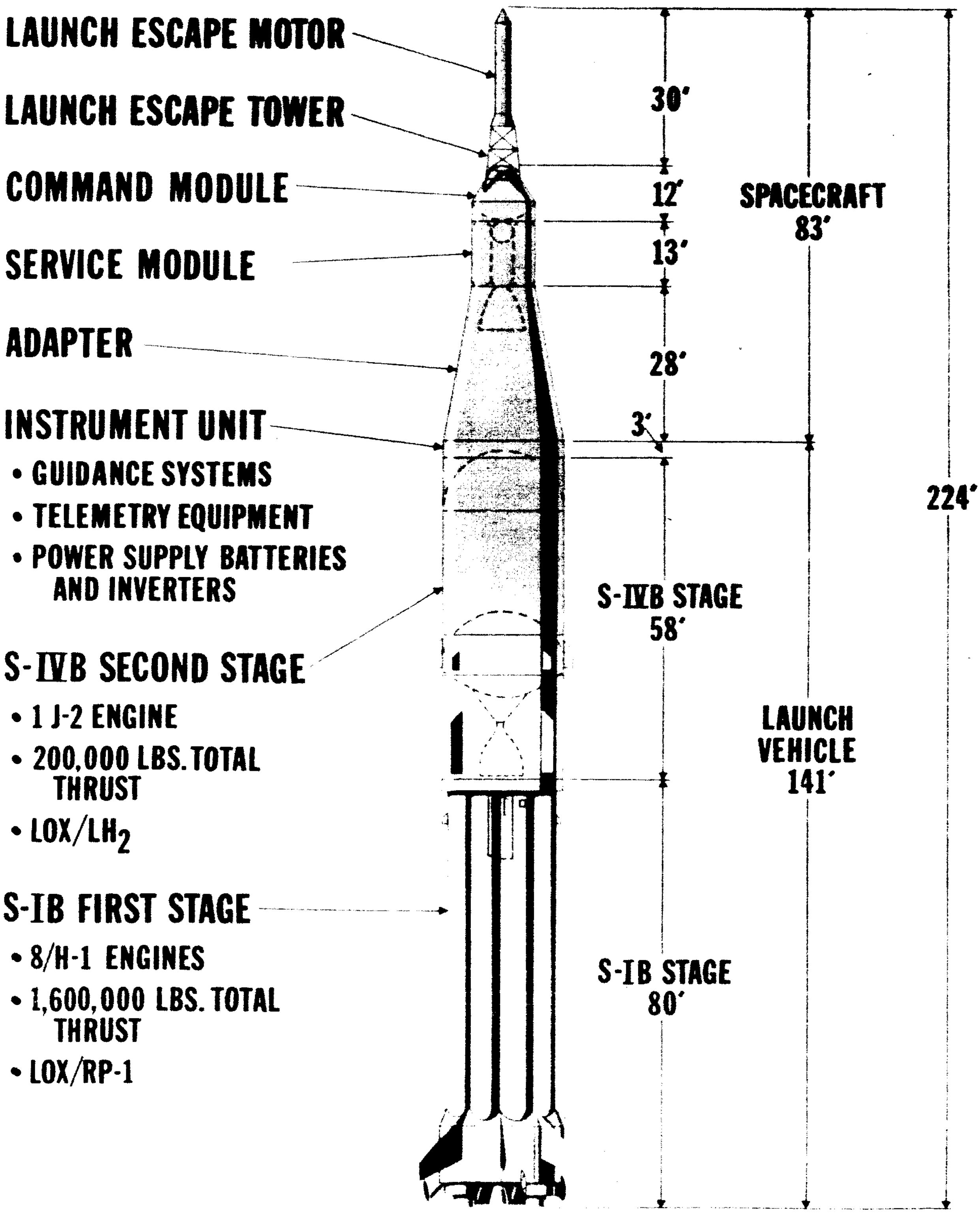
Chrysler assembles the stages at the NASA-Michoud Assembly Facility in New Orleans and tests them at the NASA Marshall Space Flight Center, Huntsville, Ala.

<u>Second stage</u> -- The stage is 58 feet long and 21.7 feet in diameter. Its Rocketdyne J-2 engine, powered by liquid hydrogen and oxygen, generates 200,000 pounds thrust. After first stage burnout it lofts the spacecraft to about 135 miles altitude.

Dry weight of the stage, including the interstage which connects the first and second stages, is 29,700 pounds. The stage operates about 7.5 minutes to achieve orbital speed and altitude, but will not orbit on this flight. The J-2 engine will burn approximately 60,000 gallons (36,000 pounds) of liquid hydrogen and some 20,000 gallons (190,000 pounds) of liquid oxygen.

Douglas Aircraft Co. builds the second stage at its Huntington Beach, Cal., facility and tests it at the Sacramento Test Center.

APOLLO/SATURN IB SPACE VEHICLE



LAUNCH WEIGHT 1,312,300 LBS.

SPACE VEHICLE

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<u>Instrument Unit</u> -- The 260-inch diameter instrument unit is three feet high and weighs 4,500 pounds. It is an unpressurized, load-supporting structure of sandwich-type bonded construction. Honeycomb-panel "cold plates" are attached to welded brackets on the interior skin. The electrical and electronic equipment is mounted on the plates for cooling purposes.

The instrument unit has the electrical and mechanical equipment which guides, controls and monitors vehicle performance from liftoff until after insertion of the payload. It controls first stage powered flight, stage separation, second stage powered flight, and further flight to the point of payload separation.

On this mission the instrument unit will control the vehicle through second stage powered flight. Some ten seconds later the spacecraft is separated.

Equipment includes guidance and control, electrical, measurement and telemetry, radio frequency, instrumentation, range safety command system, environmental control, and emergency detection systems (EDS).

Systems include the ST-124-M-III inertial platform, the launch vehicle digital computer and the electrical equipment required for launch vehicle performance.

The instrument unit was designed by the Marshall Center. International Business Machines Corp., Federal Systems Division, is the IU contractor for fabrication, system testing, and integration and checkout with the launch vehicle, with major elements coming from Bendix, IBM, Electronic Communications, Inc.

LAUNCH COMPLEX 34

The AS-201 space vehicle will be launched from Complex 34, Cape Kennedy, the pad used for the first four Saturn I launches and the first Apollo/Uprated Saturn I last Jan. 26.

The complex consists of a 430-foot diameter launch pad, a mobile service structure, a launch control center and related ground support equipment, vehicle service systems including RP-1 (kerosene) fuel, liquid oxygen and liquid hydrogen used for launch vehicle cooling and pressurization.

Preparations are directed during checkout, countdown and launch from a dome-shaped launch control center located about 1,000 feet from the pad. The control center (blockhouse) is constructed of steel and concrete with a roof designed to withstand pressures of 2,188 pounds per square inch -- well above safety limits for the 300-man crew inside, in event of an explosion in the pad area.

The mobile structure is wheeled into place during launch preparations and rolls back 680 feet from the pad about three hours before liftoff. It stands 310 feet high and weighs some 3,500 tons. Seven fixed platforms and eight enclosed, retractable working areas are in the service structure. These give the service crew access to all sections of the launch vehicle and spacecraft.

Hurricane doors, 44 feet tall, provide weather protection for the first stage, and retractable silo sections provide similar cover for the S-IVB, instrument unit and spacecraft. Following the successful Saturn I series, Complex 34 was modified for the Uprated Saturn I program. The work included installation of doors capable of protecting the first stage from hurricane winds, silos for the upper stages and spacecraft, a new anchoring system for the service structure, reinforcement of structures, frames and propellant systems.

Additional modifications were made to the swing arms, instrumentation, pneumatics and environmental control system for the Saturn.

Modifications required to "man rate" Complex 34 for the Apollo program included installation of a spacecraft access arm and a high speed elevator in the umbilical tower for the flight crews.

CAMERAS

Motion Pictures

Saturn First Stage

Two 16 mm Milliken movie cameras mounted on the forward end of the first stage will record first and second stage separation, operation of the second stage ullage rockets and J-2 engine ignition.

The cameras will begin operating approximately three seconds before stage separation and will be ejected 25 seconds after separation at an altitude of about 49 miles.

The cameras are enclosed in waterproof capsules. The capsules have aluminum shells and stainless steel nose sections, quartz windows, reentry equipment and recovery aids.

During descent, paraballoons inflate at approximately 14,000 feet to keep the capsules afloat. Radio beacons and dye markers will assist an Air Force recovery team to locate them.

These camera systems were flown on the previous Uprated Saturn missions. One camera was retrieved on each flight.

Chrysler Corp. assembled and tested the camera packages for the NASA Marshall Space Flight Center.

Spacecraft

Four 16 mm Milliken motion picture cameras will be mounted in the Command Module to record instruments, chute deployment and reentry. One camera will be mounted on the flat plate in the egress hatch (in the nose of the CM) to record jettisoning of the Apex cover, parachute deployment and reentry. The second camera is on a pallet where the right astronaut couch would be located, and will record liftoff and reentry through the right-hand window. Two instrument cameras, one on the left and one on the center, will record instruments and displays during the flight.

Camera/Location	Speed/Timing
1) Apex - egress hatch	32 FPS - reentry-30,000 ft. to splashdown
2) Astro - right window	10 FPS - liftoff to T plus 10 T plus 72 to splashdown
3) Instrument - left pallet and center	10 FPS - T-45 to T Plus 10 and other significant periods

Television

A small television camera mounted on a cross beam atop the instrument unit will photograph the movement of the spacecraft-lunar module adapter panels as they fold back to free the spacecraft.

The panels will enclose the Apollo lunar module on later missions. They are hinged about seven feet above the instrument unit and are to fold back some 35 degrees.

An assembly of eight mirrors will allow the forward pointing camera to record the movement of all four panels. Four lights, one on each panel, will illuminate the area during camera operation.

The camera will be turned on at liftoff and will operate 12-15 minutes. It may photograph clouds and the Earth as the stage falls back into the atmosphere. It has standard commercial scan rates, 525 lines and 30 frames a second. The transmitter is located in the instrument unit.

The Antigua tracking station will monitor the transmission and record it.

The General Electrodynamics Corp. builds the television system under the direction of the NASA Marshall Space Flight Center.

APOLLO PROGRAM MANAGEMENT

The Apollo/Saturn program is directed by Dr. George E. Mueller, Associate Administrator for Manned Space Flight, NASA Headquarters, Wash., D.C., Apollo Program Director is Maj. Gen. Samuel C. Phillips, USAF, NASA's Office of Manned Space Flight. E. E. Christensen is Director of Mission Operations.

The Marshall Space Flight Center, Huntsville, Ala., is responsible for development of the Saturn launch vehicles. Dr. Wernher von Braun is Director of the Center.

The Manned Spacecraft Center, Houston, is responsible for development of the Apollo spacecraft, crew training and in-flight mission control from the Manned Flight Mission Control Center located at MSC. Dr. Robert R. Gilruth is Center Director.

The John F. Kennedy Space Center, Cape Kennedy, Fla. is responsible for Apollo/Saturn launch operations. Dr. Kurt R. Debus is Center Director.

The Goddard Space Flight Center, Greenbelt, Md., is responsible for management of the NASA Manned Space Flight Tracking Network. Dr. John F. Clark is Director.

Mission Officials:

Mission Director -	Brig. Gen. C. H. Bolender, USAF, Mission Operations NASA Headquarters, Wash., D.C.
Launch Director -	Rocco A. Petrone, Director of Launch Operations, Kennedy Space Center, Fla.
Flight Director -	John D. Hodge, Flight Operations, MSC, Houston
Manager, Apollo Spacecraft Program -	Dr. Joseph F. Shea MSC, Houston
Manager, Uprated Saturn I Launch Vehicle Program -	Lee James MSFC, Huntsville

MAJOR APOLLO/SATURN IB CONTRACTORS

SATURN IB

First Stage	Chrysler Corp. Space Division New Orleans
H-1 Engines	Rocketdyne Division North American Aviation, Inc. Canoga Park, Cal.
Second Stage	Douglas Aircraft Co., Inc. Missile & Space Systems Div. Huntington Beach, Cal.
J-2 Engine	Rocketdyne Division North American Aviation, Inc. Canoga Park.
Instrument Unit	International Business Machines Corp. Federal Systems Division Huntsville, Ala.
ST-124M Inertial Platform in the Instrument Unit	Bendix Corp. Eclipse Pioneer Div. Teteboro, N.J.

Apollo Spacecraft

Command Module, Service Module and LEM Adapter	Space & Information Systems Div. North American Aviation, Inc. Downey, Cal.

Subcontractors for Major Spacecraft Systems

Ablative Heat Shield Material	Avco Research and Development Div. Wilmington, Mass.
Brazed Honeycomb Panels	Aeronca Manufacturing Co. Middletown, Ohio
Command Module Attitude Control and Stabilization Engines	Rocketdyne Div. of North American Aviation Canoga Park, Cal.

Communications & Data System	Collins Radio Co. Cedar Rapids, Iowa
Control Programmer	Autonetics Div. of North American Aviation Anaheim, Cal.
Earth Landing (Parachute) System	Northrop Corp., Ventura Div. Newbury Park, Cal.
Environmental Control System	AiResearch Div. of Garret Corp. Los Angeles
Fuel Cell	Pratt and Whitney Div. United Aircraft Corp. Hartford, Conn.
Launch Escape and Pitch Control Motors	Lockheed Propulsion Co., Redlands, Cal.
Service Module Reaction Control System	The Marquardt Corp. Van Nuys, Cal.
Stabilization and Control System	Honeywell, Inc. Minneapolis
Telemetry Data Processing System	Radiation Inc. Melbourne, Fla.
Tower Jettison Motor	Thiokol Chemical Corp. Elkton, Md.

Apollo Guidance and Navigation System

Design and Development	Instrumentation Laboratory Massachusetts Institute of Technology Cambridge, Mass.
Manufacture, assembly, testing and subsystem integration	AC Electronics Div. of General Motors Corp. Milwaukee
Subcontractors - Digital computer and display keyboards	Space and Information Div. Raytheon Company Sudbury, Mass.
Optical subsystem (sextant & telescope)	Kollsman Instrument Corp. of Standard Kollsman Industries, Inc. Syosset, N.Y.

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Ground Support Equipment

Apollo Spacecraft Acceptance Checkout Equipment (ACE)	General Electric Co. Apollo Support Dept. Daytona Beach, Fla.
Saturn 110A Checkout Computer and Display Systems	Radio Corporation of America Aerospace Systems Div. Van Nuys, Cal.

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